Task-Evoked Activity Outperforms Spontaneous Neural Fluctuations in Characterizing Cortico-Cerebellar Connectivity

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Presentation Abstract Summary Spontaneous fluctuations in the fMRI signal are commonly used to reveal functionally related regions in the human brain. This approach relies on the assumption that spontaneous neural activity varies sufficiently across networks to dissociate them. However, even filtered fMRI time-series include substantial non-neuronal noise components that may bias connectivity estimates. An alternative experimental approach to address this problem is to de-correlate activity in different networks purposefully through a rich and varied set of tasks. Here we compare these two approaches in their ability to characterize the organization of neocortical-cerebellar functional networks. We used 29 task conditions, spanning a broad range of motor and cognitive domains. We estimated connectivity weights using either the activity fitted by our linear model (task-evoked activity) or the residuals (spontaneous neural fluctuations and non-neural fMRI noise). We evaluated the models by their ability to predict the cerebellar activity patterns on a novel set of tasks, only using the neocortical activity patterns. We found that the task-evoked connectivity model performed better than models based on residual or complete time series. These results suggest that connectivity estimates based on task-evoked activity may have advantages over resting-state data to reveal meaningful neuronal organization.

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